# DISCUSSION OF PAPER BY MERRIL EISENBUD*

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DR. Merril Eisenbud's paper depicts dramatic reductions in concentrations of sulfur dioxide and particulate matter in New York City over the last decade. One could argue about the representativeness of the data with respect to such factors as the location and relocation of monitors, changes in the air-quality sampling methods over the years, monitoring interferences from other pollutants, and the geographic coverage of a given monitor. Nevertheless, the general reductions reported by Dr. Eisenbud are significant enough in magnitude to outweigh the effects of any of these factors, particularly when one examines trends in annual average concentrations as opposed to short-term maxima.

The Environmental Protection Agency (EPA) has confirmed that the quality of New York City's air has improved considerably with respect to sulfur dioxide and particulate matter by its recent affirmation that no New York City site currently exceeds the primary, health-related ambient air-quality standards for sulfur dioxide and particulate matter. Further verification of the attainment of the primary ambient standards in New York City must await full implementation of quality-assurance procedures to address the efficacy of the method used to measure sulfur dioxide and the location of monitors with respect to height and displacement from normal breathing levels.

Reviewing trends in sulfur dioxide concentrations from 1970 through 1975 at three separate monitoring locations (Queens, upper Manhattan, and lower Manhattan), our analysis confirms the overall citywide trends

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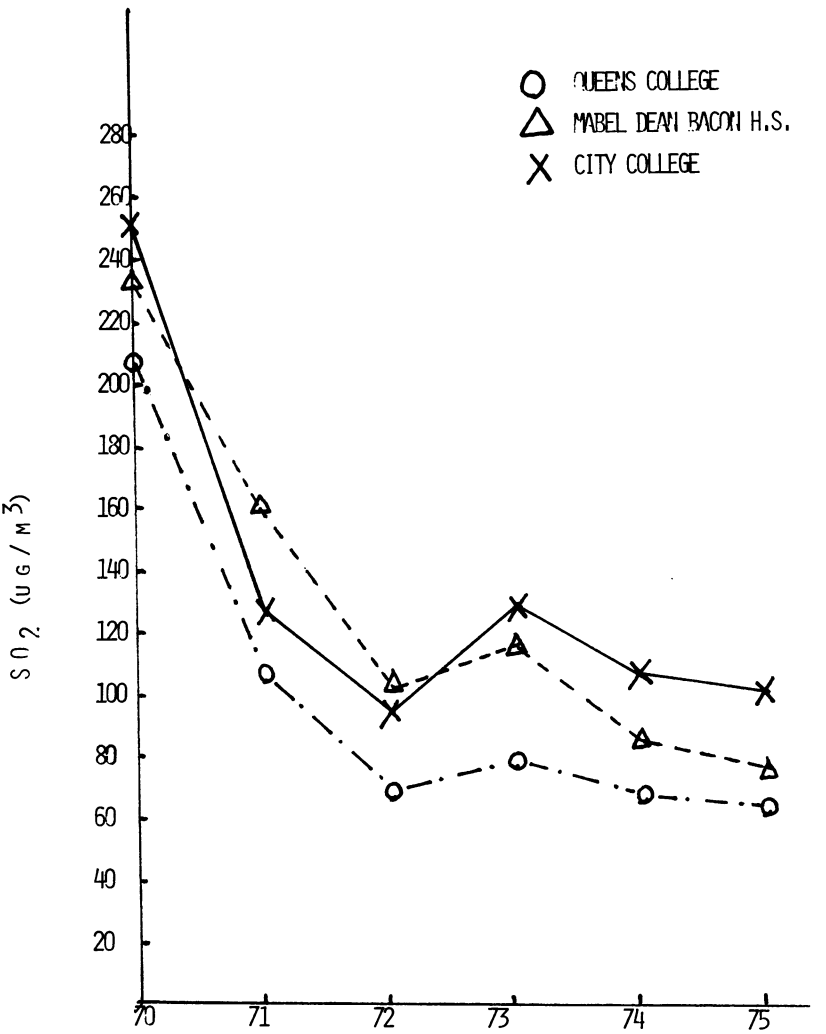


Fig. 1. Ambient $SO_2$ trend analysis.

shown by Dr. Eisenbud at each location (Figure 1). A similar conclusion can be drawn for total suspended particulate matter concentrations by examining the trends at these same locations (Figure 2). The degree of improvement varies from station to station and reflects the differing residential and commercial characteristics of the sites. When the New York City experience is compared with other large cities, the general downward

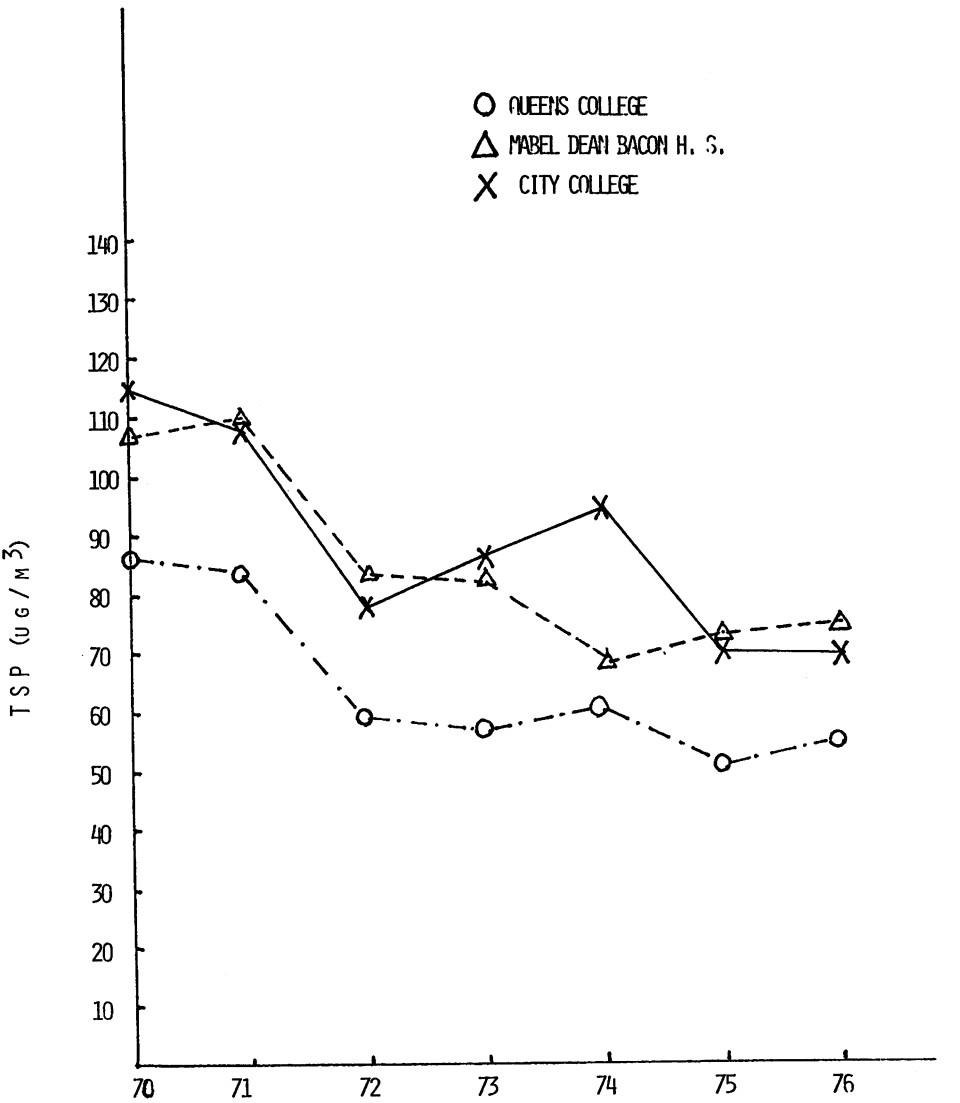


Fig. 2. Ambient TSP trend analysis.

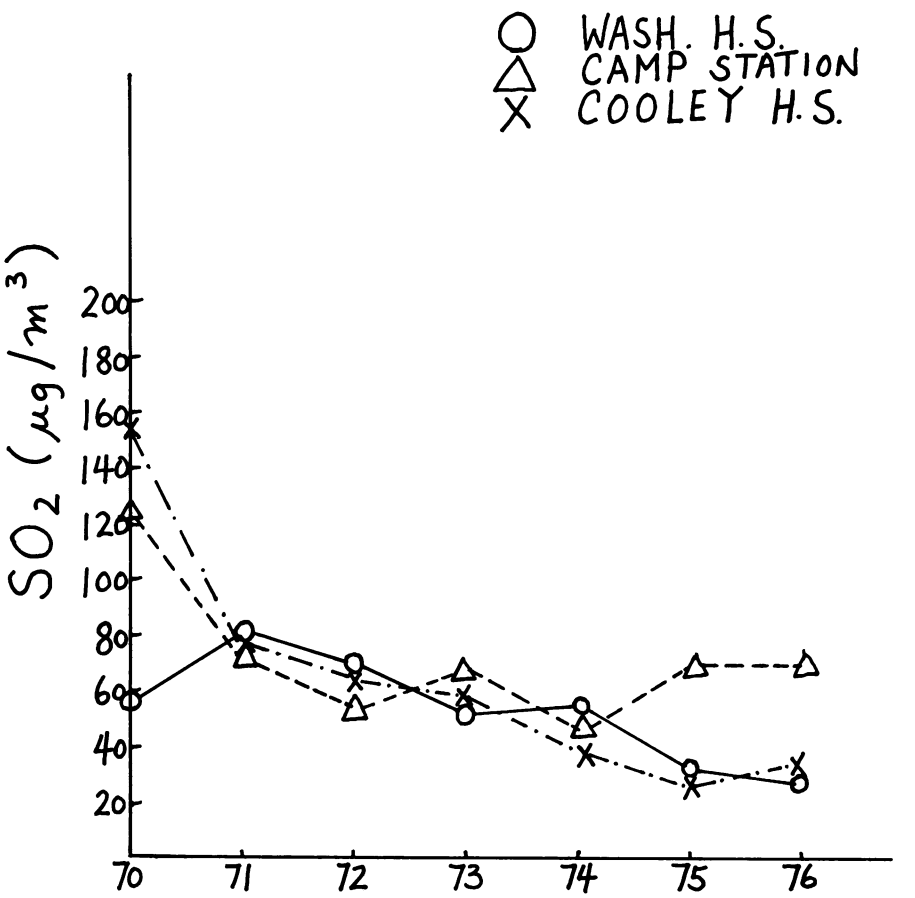


Fig. 3. Ambient $SO_2$ trend analysis, Chicago, Ill.

trend in concentrations found since 1970 is duplicated in such cities as Chicago and Philadelphia (Figures 3-6). The reasons for the reductions in Chicago and Philadelphia are similar to those for New York: introduction of low sulfur fuels to power plants, residential and commercial buildings, and implementation of stricter controls on industrial and commercial sources of particulate matter.

While the picture is quite encouraging with respect to sulfur dioxide and particulate matter, it is equally distressing with respect to carbon monoxide and photochemical oxidants, the other two conventional pollutants for

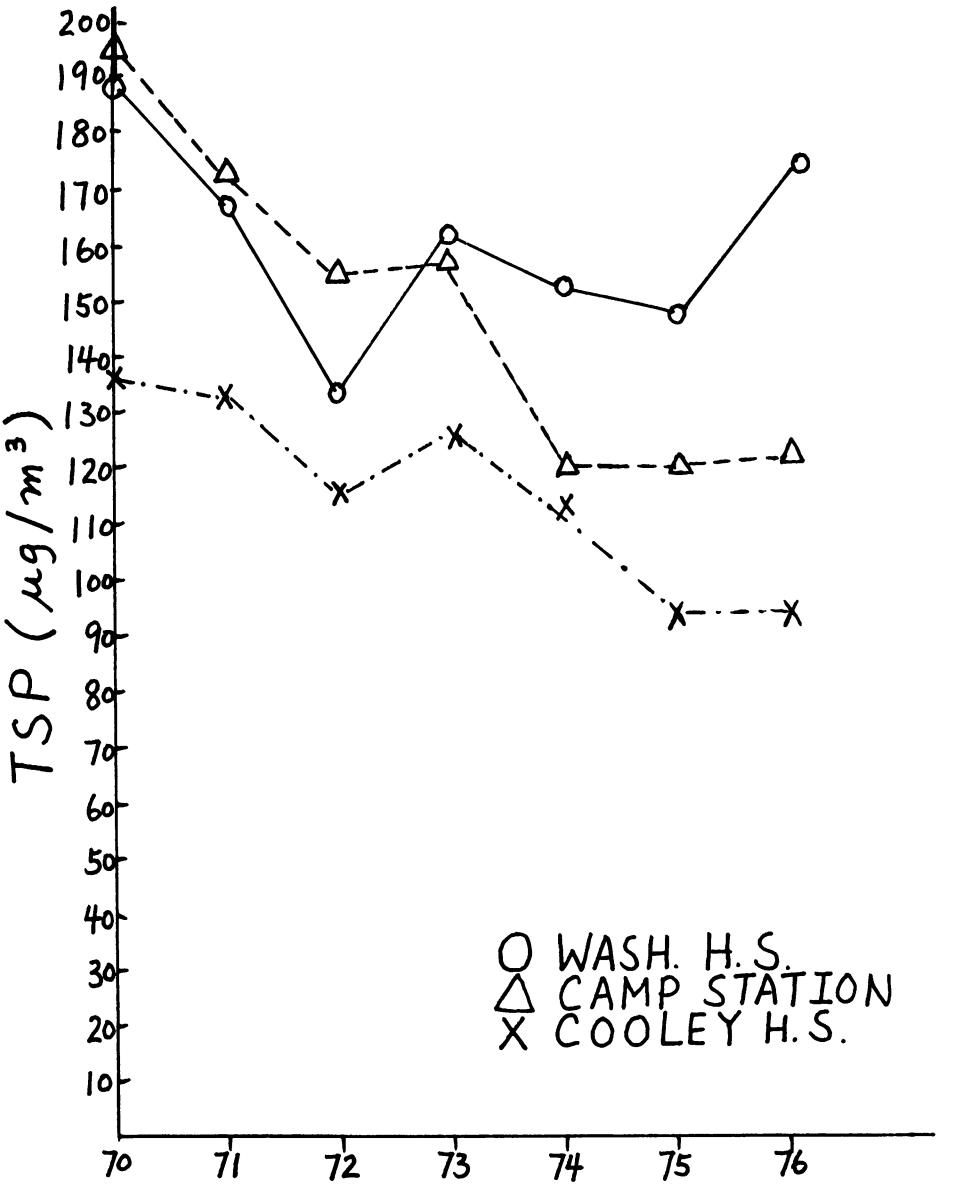


Fig. 4. Ambient TSP trend analysis, Chicago, Ill.

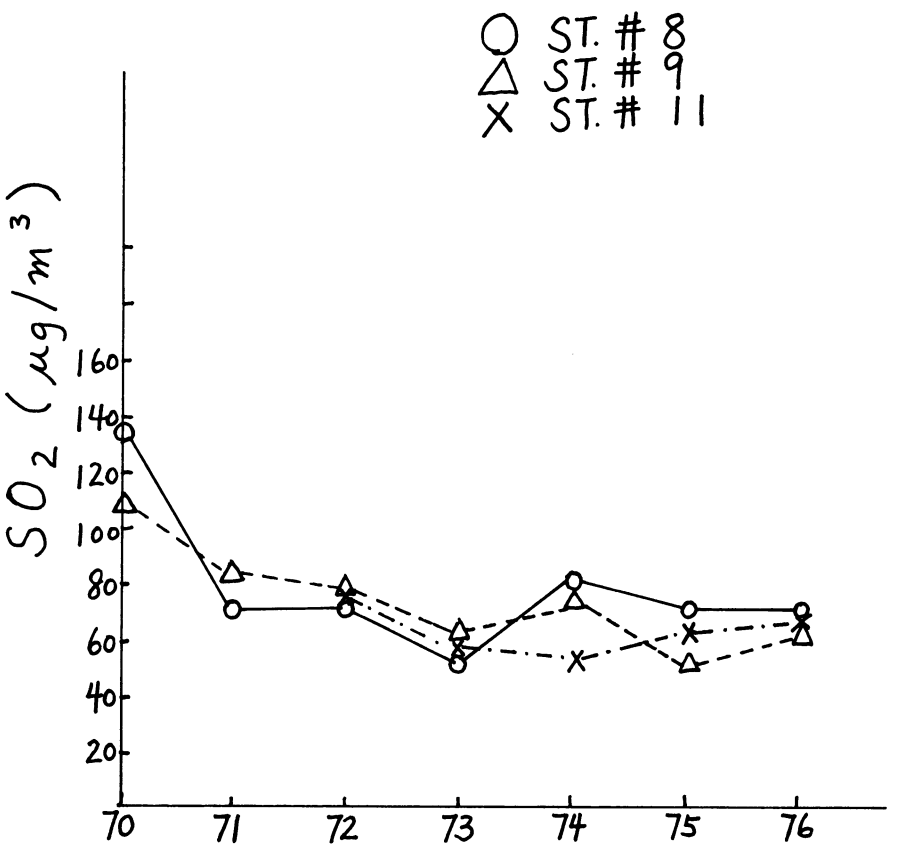


Fig. 5. Ambient $SO_2$ trend analysis, Philadelphia, Pa.

which national ambient air-quality standards were set. Carbon monoxide concentrations are shown (Table I) to exceed the national standards of 9 ppm. as an eight-hour average more than 75% of the time. On individual days, eight-hour average concentrations have exceeded the national standard by a factor of three. Photochemical oxidant (ozone) concentrations in New York City have exceeded the one-hour standard of 0.08 ppm. on 54 of the approximately 150 days between June and October (Table II) when elevated oxidant levels could occur.

High concentrations of carbon monoxide and photochemical oxidants are primarily attributable to the excessive use of motor vehicles in this area and to lack of success in effectively controlling hydrocarbon emissions

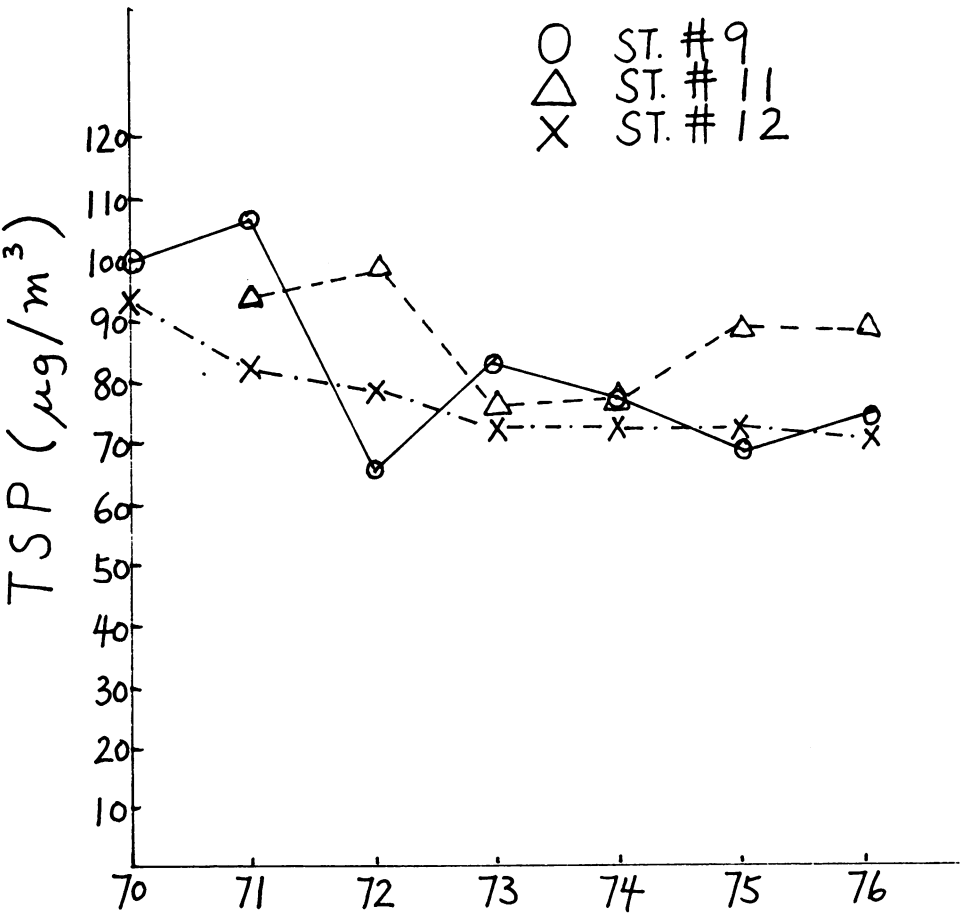


Fig. 6. Ambient trend analysis, Philadelphia, Pa.

when dealing with the automotive pollution problem. With the passage of the 1977 Clean Air Act Amendments this situation may change.

The city does not appear to have a problem in meeting the current annual average standard (0.05 ppm.) for nitrogen dioxide, but EPA is in the process of setting a short-term standard for this pollutant and, depending on the level selected, control measures may have to be developed.

In addition to the five pollutants mentioned (i.e., sulfur dioxide, particulate matter, carbon monoxide, photochemical oxidants, and nitrogen dioxide) there are a number of toxic and carcinogenic compounds which

TABLE I. 1976 EIGHT-HOUR. 7:00 A.M. TO 3:00 P.M. CARBON MONOXIDE SUMMARY FOR NEW YORK CITY

| *Location* | *Eight-hr. maximum (ppm.)* | *2nd eight-hr. maximum* (ppm.)* | *Annual average (ppm.)* | *No. of days eight-hr. standard exceeded** | *No. of data days* | *Percentage of days in violation* |
|---|---|---|---|---|---|---|
| 121st Street<br>Bureau of Laboratories | 10.3 | 9.0 | 3.2 | 1 | 252 | 0.4 |
| 59th Street bridge<br>W. 59th Street and Bridge Plaza | 29.9 | 29.1 | 14.2 | 309 | 313 | 98.7 |
| 350 Canal Street<br>Post Office | 14.0 | 13.0 | 6.7 | 103 | 392 | 26.3 |
| 110 E. 45th Street<br>45th Street and Lexington Ave.<br>Post Office | 25.8 | 20.9 | 6.7 | 250 | 330 | 75.8 |

*Federal ambient air standard 9 ppm., 2nd maximum.

TABLE II. NEW YORK CITY AIR MONITORING SYSTEM ANNUAL AVERAGES 1973 THROUGH 1976 AND AIR QUALITY FOR CALENDAR YEAR 1976. CONTINUOUS AIR MONITORING SITES PHOTOCHEMICAL OXIDANTS (OZONE)—CHEMILUMINESCENCE

| Station | Annual mean | | | | One-hour average | | |
|---|---|---|---|---|---|---|---|
| | 1973 | 1974 | 1975 | 1976 | Maximum* not to exceed 0.08 ppm. Air quality–1976 ppm. | | No. of days with values exceeding 0.08 ppm. |
| Bronx H.S. of Science | — | — | — | 0.015 | 0.220 | (110)† | 27 |
| Morrisania Health Ctr. | — | — | — | 0.009 | 0.212 | (59)† | 16 |
| Queens College | — | — | — | 0.021 | 0.200 | (278)† | 50 |
| Central Park Arsenal | — | — | — | 0.061 | 0.250 | (204)† | 41 |
| Mabel Dean Bacon H.S. | — | — | — | 0.004 | 0.210 | (53)† | 8 |
| Greenpoint Poll. Ctrl. | — | — | — | 0.004 | 0.260 | (188)† | 30 |
| Brooklyn Library | — | — | — | 0.006 | 0.233 | (315)† | 54 |
| Sheepshead Bay | — | — | — | 0.016 | 0.255 | (33)† | 6 |
| 51 Astor Place | 0.015 | 0.012 | 0.009 | 0.009 | 0.164 | (60)† | 18 |

*Above air quality standards are identical with Federal EPA standards in that the maximum one-hour standard of 0.08 ppm. is a value not to be exceeded more than once in any 12-month period.
†Denotes a violation of ambient air quality standards.
This is the maximum one-hour average that was measured during the period January 1 through December 31, 1976. Number in parenthesis is the total number of one-hour averages exceeding 0.08 ppm.

are known or suspected to be emitted to the ambient air in the New York area. Some have been identified and measured on a very limited basis; most have not. Even for those that have been identified, definition of their significance as threats to public health has been unsuccessful. These pollutants and their impacts are currently the subject of extensive study by EPA. Our findings will greatly influence future pollution-control strategies.

In closing, I would like to describe briefly some work done by EPA to characterize the trends in population exposure to pollution.

For a number of years the New York City Department of Air Resources has depicted the city's air-pollution problem through isopleth maps (Figure 7), a technique that allows us to fill in data gaps between monitoring locations and to predict expected concentrations of a given pollutant over areas of the city not covered by monitoring stations. By combining this information with information about the distribution of the general population or selected segments of it, one can compute the percentage of the


Fig. 7. Sulfur dioxide (ppm.) arithmetic average calendar year 1973. Aerometric Network, Department of Air Resources, New York City. Underlined values represent averages for less than a full year. Lines of constant concentration drawn for every 0.01 ppm.

city's population exposed to a given level of air pollution. EPA has developed a computer model of the city (Figure 8) to do just this.

For total suspended particulates, the results show (Figure 9) that in 1970 60% of the population lived in areas which exceeded the national annual standard for this pollutant. By 1973 air quality had improved to the point that only 12% of the population was exposed to these levels. In 1976 all areas were determined to have attained the standard so that in 1976 100%

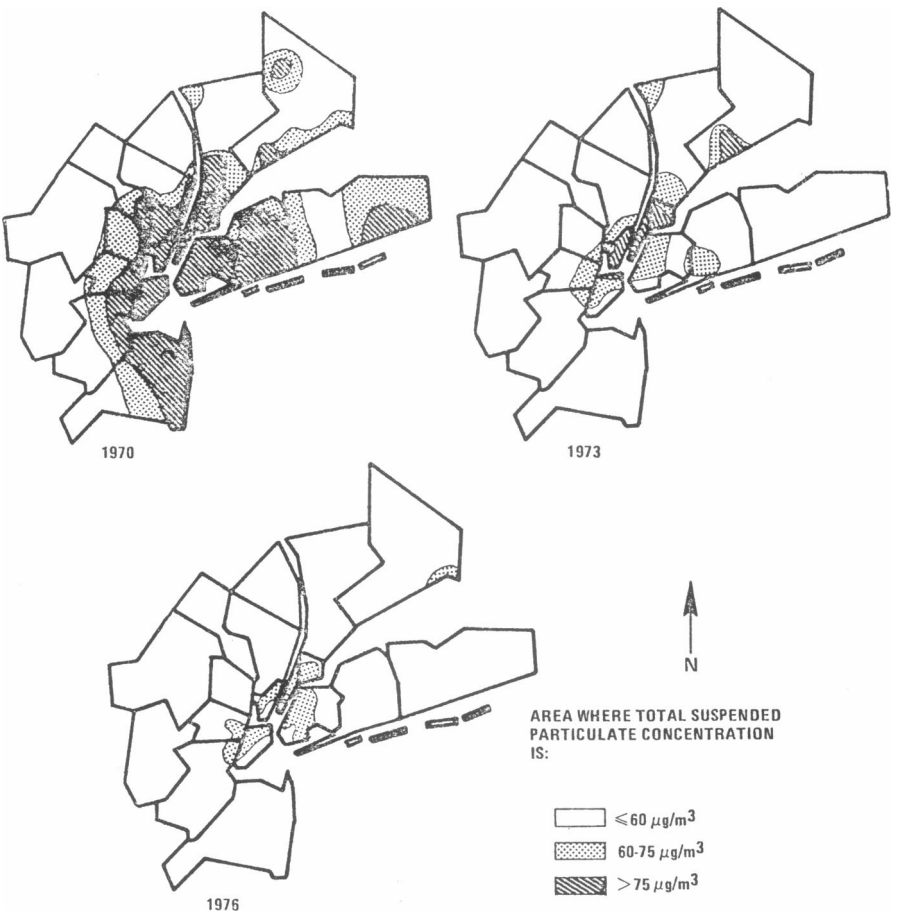


Fig. 8. Isopleth of annual geometric mean concentrations of total suspended particulates in 1970, 1973, and 1976.

of the population was in areas where no adverse health effects would be incurred from existing concentrations of suspended particulates. A similar analysis for sulfur dioxide (Figure 10) shows that as late as 1971 100% of the population was exposed to air quality above standards. By 1973 this figure had dropped to 80. On the basis of the 1978 data, the analysis shows that 100% of the population was protected from adverse health effects of sulfur dioxide.

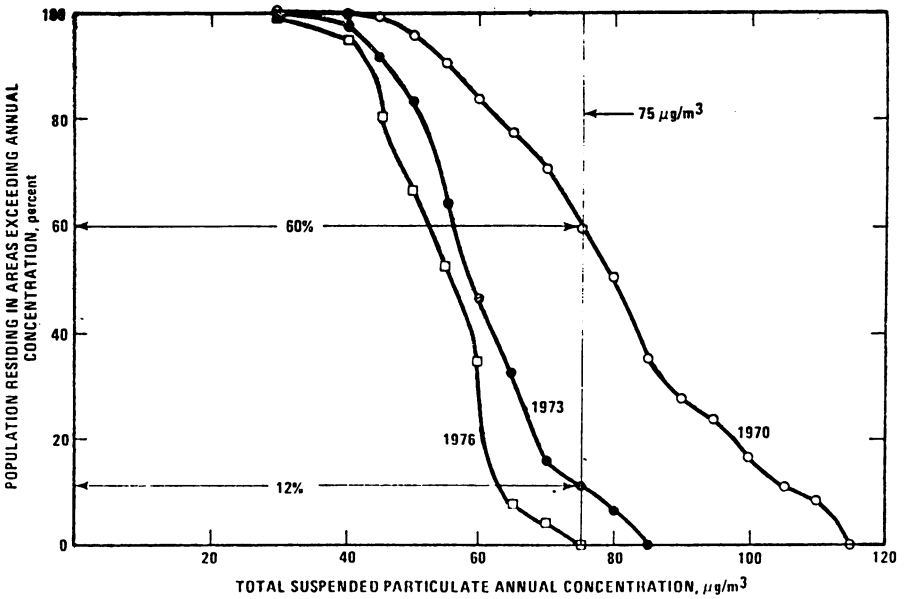


Fig. 9. Decrease in population exposed to total suspended particulates in New York-New Jersey-Connecticut air quality control region, 1970-1976.

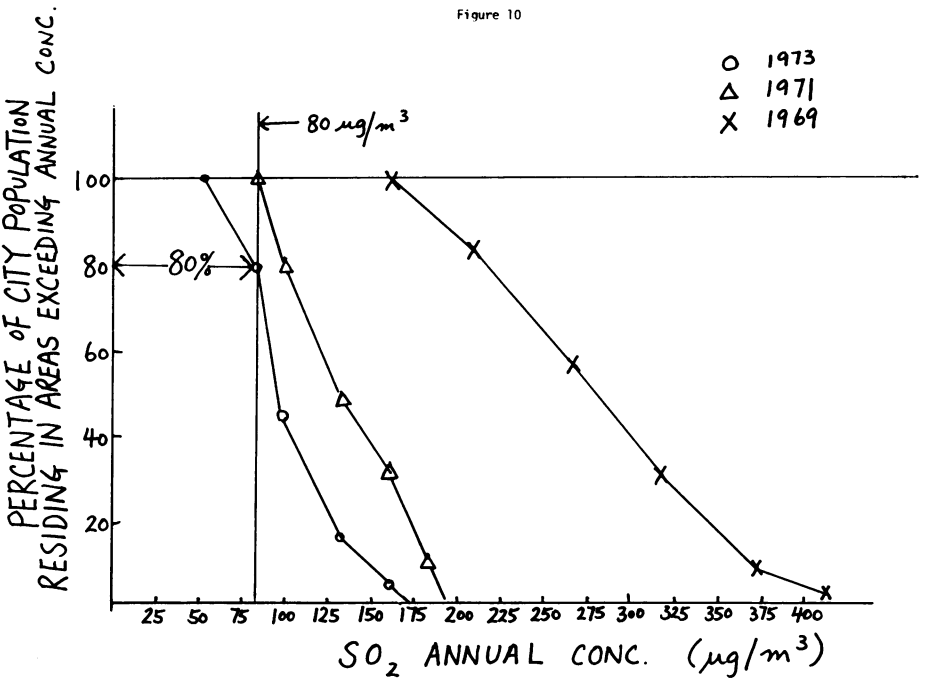


Fig. 10

The EPA study also examined the exposure of various sensitive segments of the population, including the elderly and school-age children, to determine their exposure levels. The findings, as might be expected, resembled that of the general population, and though this population exposure technique needs much refinement, I believe its usefulness is apparent.